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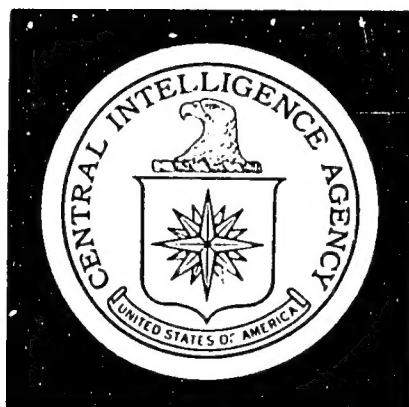
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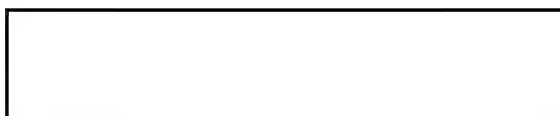
DIRECTORATE OF
INTELLIGENCE

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Intelligence Memorandum

*Communist China: Production, Imports,
And Uses Of Computers*

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
February 1971

INTELLIGENCE MEMORANDUM

Communist China: Production, Imports,
And Uses Of Computers

Introduction

The mastery of computer technology and the large-scale production of modern computers are essential if Communist China is to realize its aspiration of becoming a modern industrial nation and military power. In the United States, and the industrial West generally, the operations of industry have been revolutionized by the application of computers not only for data processing but also for automatic process control. In the West, and increasingly in the USSR, computers have become an essential ingredient of advanced weapons systems and in the design, production, and control of these systems. For China, the military uses are the priority area in the initial development of its computer industry.

This memorandum describes the development of a capability to produce computers in Communist China, analyzes the imports of modern computers over the last decade, and describes the various uses made of computers. The memorandum contains a detailed listing of the computers imported by China from the Free World in 1958-70. Another listing gives the probable consignees within China for imported computers where destination is known or can be reasonably estimated, including military production ministries.

Note: This memorandum was prepared by the Office of Economic Research and coordinated within CIA.

Background

1. The history of the development and use of computers in Communist China fits readily into the general pattern of China's economic development under the Communists. For example, the First Five-Year Plan (1953-57) was a period of rapid increases in the production of basic industrial products, such as coal and steel, and at the same time a period of laying the foundation for important branches of the machine-building industries -- including computers. The extensive Soviet economic and technical aid to China in the 1950s included the supplying of computers to China and assistance in starting up domestic production of Soviet models. Following the withdrawal of Soviet support in 1960, China became increasingly dependent on Japan and Western Europe for modern equipment, materials, and technology. The most modern part of China's present stock of computers have been imported from Japan, France, the United Kingdom, and West Germany. Finally, the priority use of China's computers for advanced weapon systems, in the modernization of heavy industry, and in the conduct of military-related research mirrors the thrust of China's general economic development -- toward the support of a modernized military establishment.

Development of Production Capabilities

2. Development of computers in Communist China began in 1956 with the establishment of the Academy of Sciences Institute of Computation Techniques at Peking. By 1959, additional computer research institutes had been established in Shanghai, Shen-yang, Tsinan, and Ch'eng-tu; computer courses were being taught at most of the large Chinese universities, and computer research and development were under way at Fu-tan University in Shanghai, Nanking University, Ch'ing-hua University in Peking, Northeast Engineering College in Shen-yang, Peking University, and Shantung University. During this early period, however, China had little native capability for the development of computers, and the progress achieved resulted largely from substantial Soviet assistance in the form of technical information, advisers, and computers for use as prototypes. With this help the Chinese succeeded before 1960 in reproducing

experimentally models of Soviet digital and analog computers.*

Digital Computers

3. The loss of Soviet aid in 1960 did not bring Chinese computer development to a halt. Serial production of digital computer model DJS-1 -- a copy of the Soviet M-3 -- began in 1962. This small vacuum tube computer was capable of only 1,800 operations per second (ops). An improved version, the DJS-2, was put into production in 1963. Modeled after the Soviet BESM-2, this computer was capable of 10,000 ops. By 1964 the Chinese were producing a much improved version of the Soviet M-20 called the 16-K or model 119. This computer, which represented a significant technical advance in China's capabilities, was capable of 50,000 ops and incorporated some semiconductor components. The 119 probably incorporated components and logical design features comparable to those of some US production models that were being delivered in 1959.

4. The Chinese claimed in 1964 that they were constructing their first large, completely transistorized digital computer. This computer, probably the 109 model, was first displayed to visitors in China in 1966 (see Figure 1). The 109, with a capability of 60,000 ops, is probably being serially produced as model DJS-21. The DJS-7 small transistorized digital computer was exhibited at the 1968 Fall Canton Trade Fair and the 1969 Spring Canton Trade Fair (see Figure 2). This computer has a

* Computers are of two fundamentally different classes, digital and analog. Digital computers, which perform numerical operations at an extremely rapid pace according to an internally stored program, offer major advantages in accuracy and range of applications and account for most of the computers in operation and production today. Analog computers, which solve problems by using electrical quantities (for example, voltages) to represent numbers, usually are used in engineering applications such as the design of aircraft and missile systems.

Figure 1

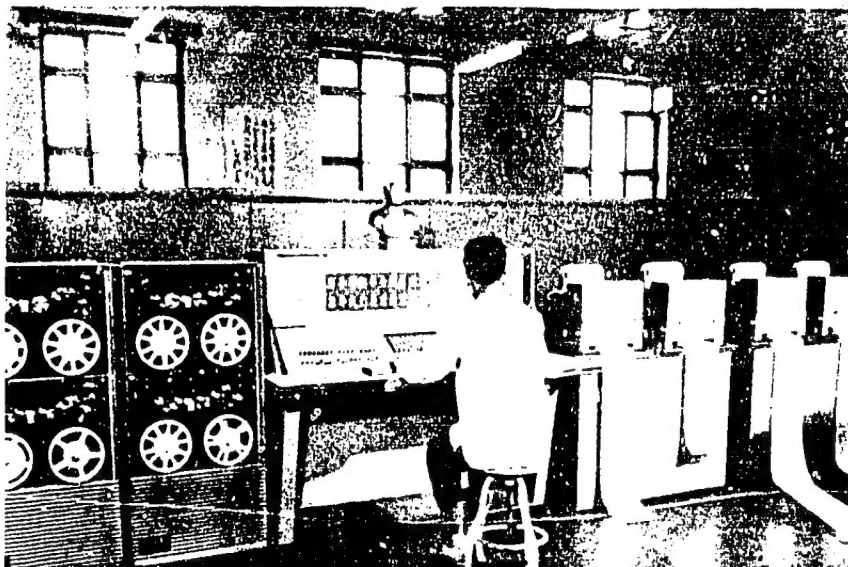
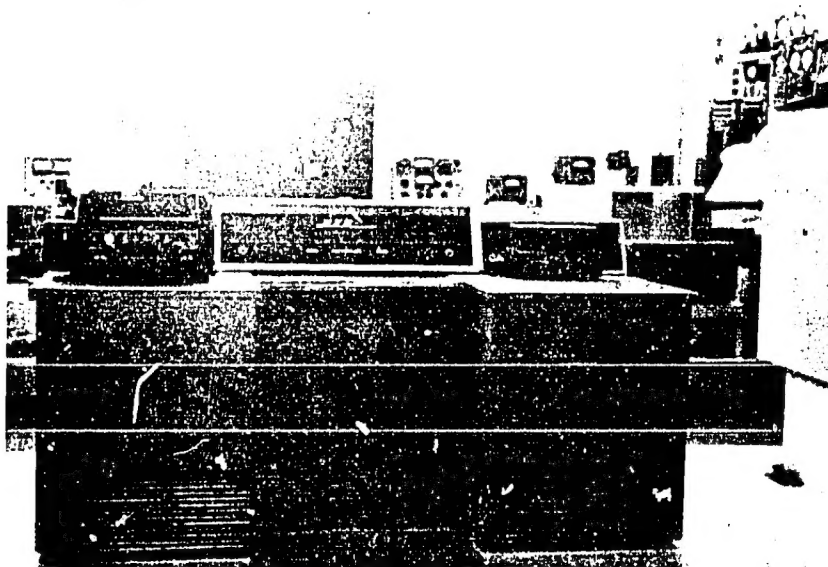


Figure 2



capability of 2,700 ops, and if all components are in the desk as pictured, significant advances in the miniaturization of computers have been made. The computer also has a distinctly Western appearance. In the 1970 Spring Canton Trade Fair the Chinese

exhibited the model DJS-6 transistorized digital computer which was reported to be capable of 100,000 ops. Since 1964 all new models of digital computers have been completely solid state, and with the completion of the DJS-6 model, the solid-state computer had finally surpassed rather than duplicated the capabilities of previous vacuum tube models. In the development of digital computers, however, China is still at least five years behind the USSR and ten years behind the United States. A list of the digital computers produced in China and their characteristics is given in Appendix A.

Analog Computers

5. The work on analog computers was even more extensive than that on digital computers, and by 1958 China had constructed more than 40 analog machines. While most of the analog computer developments that have been publicized appear to have been aimed at satisfying the needs of the developing institute or the needs of a single industry, certain models are being manufactured for more general use.

6. The small vacuum tube FM-8 analog computer which has been mass produced since 1964 was originally constructed in 1958. This computer underwent five major modifications before it was placed in serial production, but it still has an accuracy of only 1% to 5%. Other vacuum tube models in use in China are the DMJ-16B analog computer, which was in production by 1960, and the M-24, which was in production by 1965. These computers are comparable to those available in the United States in the middle 1950s. In 1966 the SJ-1 and DMJ-3 analog computers were displayed. These were the first analog machines that had a distinctly Western appearance. Also, the DMJ-3 was partly transistorized. Not until 1968, at the Spring Canton Trade Fair, however, did the Chinese exhibit a completely transistorized analog computer -- the DMJ-2. China's development of transistorized analog computers appears to have lagged behind that of digital computers. The major Chinese analog models with their characteristics are listed in Appendix A.

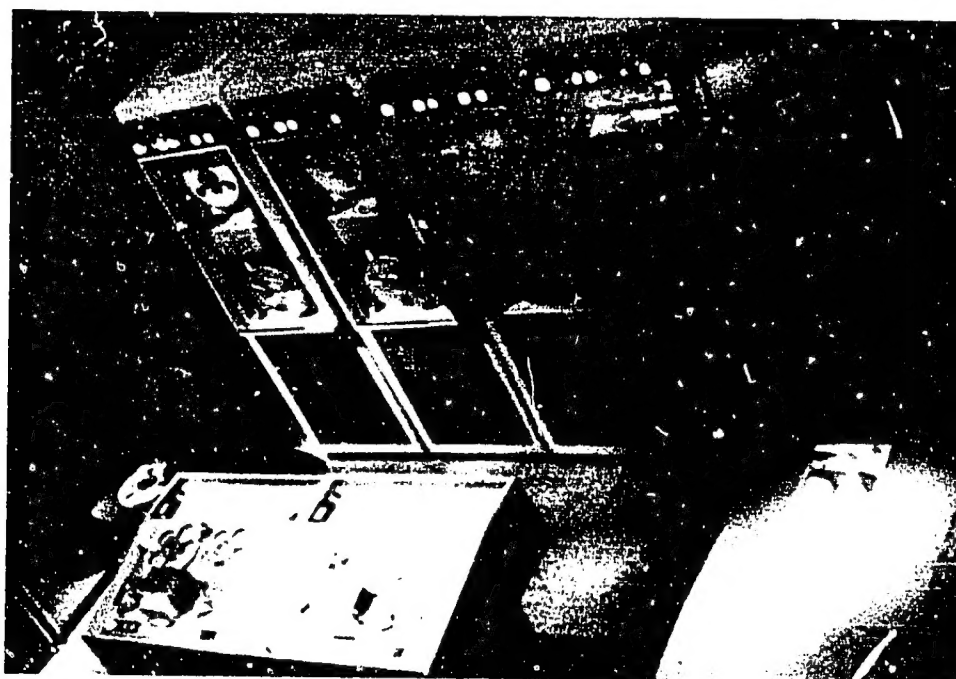
Special-Purpose Computers

7. Special-purpose computers have been developed for process control, language translation, and control of machine tools. Process control computers reportedly were first produced in the late 1950s. In 1959 the South Engineering College at Canton completed a special digital computer for machine translation of a foreign language (probably Russian), but it is doubtful whether much progress has been made in machine translation. In 1958 Ch'ing-hua University, with the assistance of the Peking Machine Tool Plant No. 1, completed a research project which resulted in the trial manufacture of two numerically controlled milling machines, each with a different type of control system. In 1964 a program-controlled engine lathe was listed in a Chinese handbook on China's machine tool industry. Several additional models of program-controlled machine tools have been produced, and in 1970 the Peking Machine Tool Plant No. 1 produced China's first program-controlled four-coordinates milling machine using an electronic computer.

Peripheral Equipment

8. The peripheral equipment and memory system of Chinese computers also have been improved. Capacity of core storage has increased from 1,000 words in the DJS-1 to 16,000-32,000 words in the DJS-6. Auxiliary storage capacity has increased from one magnetic drum of 2,048 words with the DJS-1 to four magnetic drums of 16,384 words each with the 119 and probably the DJS-6. The speed of numeric printers increased from 15 lines per minute with the DJS-21, to 1,200 lines per minute with the DJS-6. It has been reported, however, that these electro-mechanical printers have been of poor quality and that the magnetic drums vibrated about their shafts. The magnetic tape units that have been displayed in China appear to be based on earlier Soviet designs, but a Chinese unit exhibited in 1966 at the China Industrial Fair in Kyushu, Japan, appeared similar to some produced by the US Ampex Company (see Figure 3). To date, there are no reports of Chinese use of punched cards for data input or magnetic discs for auxiliary memory.

Figure 3



Software

9. Nearly all Chinese computer programs (software) evidently have been written in machine language -- that is, numeric language. Output has been completely numeric or in Chinese or English characters. The Chinese have specified that instructions and specifications associated with imported computers be in English, suggesting that Chinese software to be used with imported computers probably is written in English. At present the use of machine languages appears adequate for Chinese needs, but as China's inventory of computers increases, the need for higher level languages will increase. Despite their experience with imported software, the Chinese will encounter difficulties in developing high-level computer languages.

Output of Computers in China

10. Information on Chinese computer production is sparse perhaps because of the extensive use of these machines for military purposes. Tight security

surrounds the production and use of computers, and military personnel invariably have been associated with the development of China's more advanced models

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[REDACTED] China may have produced approximately 300 digital computers during 1960-70. For comparison, by 1968 the Communist countries of Eastern Europe had produced a combined total of about 225 computers. Probably about half of China's total computer production by the end of 1970 consisted of the small vacuum tube models DJS-1 and DJS-2. Production of vacuum tube digital computers, however, very likely has been discontinued, leaving in current production only the transistorized models DJS-6, DJS-7, and DJS-21.

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11. No information is available concerning China's output of analog computers. The small FM-8 vacuum tube analog computer was in serial production in 1964 and the M-24 in 1965. Since the DMJ-2 transistorized model was not displayed until 1968, China may still be manufacturing vacuum tube analog computers.

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Imports from the Free World

14. Except for one analog computer imported in 1958, all Chinese imports of computers from the Free World occurred during and after 1964. In 1964-70 Communist China imported from the Free World at least 72 analog, digital, and special-purpose computers valued at more than US\$23 million. Of these at least 43 were digital computers, valued at about \$19 million, and 18 were analog computers, valued at about \$2.5 million. (For a complete list of shipments, see Appendix B.)

15. Japan supplied the largest number of these computers (27), followed by France (26), the United Kingdom (17), and West Germany (2) -- see Table 1. Based on value of computers shipped, France was the leading supplier (\$10.9 million), followed by the United Kingdom (\$7.8 million), Japan (\$4.0 million), and West Germany (\$0.5 million). As shown in Table 1, most of the computers imported during 1964-70 were obtained in 1966 and 1967. The sharp drop in imports in 1968 and 1969 reflected the near cessation of purchases during 1967-68 when the Cultural Revolution was at its height.

Access to Free World Technology

16. Some of the computers imported from the Free World have incorporated advanced technology. The five Japanese Hitac 505 analog computers, imported during 1965 and 1966 in violation of COCOM export regulations, provided China with near state-of-the-art computer technology. The Hitac 505 is one of the world's best small transistorized analog computers. The six Facom digital computers obtained from Fujitsu in 1967-69 also were up-to-date machines, having been marketed only since 1965. The Fujitsu Facom models 270/10 and 270/20 are comparable in performance to the IBM 360 models 20 and 30, and the cycle time of the Facom 270/30 is faster than that of the IBM 360/50.

Table 1

Communist China: Number and Value of Computers Imported
from the Free World a/

	<u>France</u>	<u>United Kingdom</u>	<u>Japan</u>	<u>West Germany</u>	<u>Total</u>
Total					
Number	26	17	27	2	72
Thousand US \$	10,948	7,807	3,961	463	23,179
1970					
Number	6	-	-	-	6
Thousand US \$	6,000	-	-	-	6,000
1969					
Number	-	-	1	-	1
Thousand US \$	-	-	67	-	67
1968					
Number	-	-	2	-	2
Thousand US \$	-	-	408	-	408
1967					
Number	5	5	13	1	24
Thousand US \$	1,617	2,296	2,976	363	7,252
1966					
Number	10	9	8	-	27
Thousand US \$	2,306	4,311	136	-	6,753
1965					
Number	-	2	1	-	3
Thousand US \$	-	800	24	-	824
1964					
Number	1	1	1	-	3
Thousand US \$	100	400	200	-	700
1958					
Number	1	-	-	-	1
Thousand US \$	50	-	-	-	50
Year Unknown					
Number	3	-	1	1	5
Thousand US \$	875	-	150	100	1,125

a. Excluding one IBM 1401 illegally transshipped to Communist China.

17. The French firm SEA supplied China in 1966 with five Nadac 100 analog computers valued at \$300,000 or more each. This computer is similar to the large, high-precision models used in the US for aircraft and missile development projects. During 1965-67, Elliott Brothers, Ltd. of the United Kingdom shipped 12 computers to China, of which three were model-503 digital computers. The Elliott 503, with a 3.5-microsecond cycle time and with an internal storage of 8,000-131,000 words is equivalent to the IBM 704. In 1970, China reportedly received from France six CII Iris 50 digital computers. These machines, probably valued at about \$1 million each, are approximately equivalent to the IBM 360/50. The technical capabilities of the Iris 50 are superior to that of any computer known to be imported by China. In connection with the purchases of computers, the Chinese usually obtained wiring diagrams and specifications of the machines and technical guidance from the manufacturers. For example, during 1961-69 Chinese computer specialists toured computer factories in the United Kingdom and France and received a series of technical lectures from Japanese computer engineers invited to China.

18. The Chinese have also imported Free World equipment associated with computer development and operation. In 1965 a magnetic tape plant valued at \$228,000 was purchased from Japan. This plant, located at Pao-ting (about 75 miles southwest of Peking), can produce small quantities of tape suitable for computer use.

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In sum, access to Free World computer equipment and technology has been instrumental in speeding the development, production, and use of computers in China.

Inventories

19. As a result of imports and domestic production, by 1970 Communist China had an inventory of at least 73 imported computers, about 300 domestic digital computers, and an unknown number (perhaps several hundred) of domestic analog computers. The Chinese inventory compares with the inventories in 1969 of 800 computers in Eastern Europe, 5,000-6,000 in the USSR, 4,520 in France, 5,700 in West Germany, 4,575 in Japan, and about 70,000 in the United States.

20. China lags far behind Free World countries in design, production, and applications of computers. The best Chinese computers appear to be comparable in circuit technology and design to production models manufactured in the West about a decade ago. China's fastest digital computer, the DJS-6, which was first displayed in 1970, is comparable to the Swedish Data Saab D-21 which was initially marketed in 1962. The Japanese Facom 270/30 which was imported in 1967 is much bigger and faster than the DJS-6 and employs much more sophisticated circuitry. As for production capacity, China presently has much less capacity to produce computers than possessed by the several leading Free World nations in 1962.

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According to these statements, the Chinese have used their DMJ-3 analog model in solving problems relating to atomic weapons, guided missiles, and antiaircraft artillery. They also have said that the DMJ-16B analog computer has been used for electrical network analysis and that the DJS-7 digital computer is suitable for process control. They have used unspecified models to process census data and very likely are using domestically produced models in accounting operations, for inventory control, and in economic planning.

Outlook

26. During the next several years China is expected to increase its production of computers in an effort to satisfy rising requirements generated by an expanding economy and a continued priority on development and production of advanced weapons systems. Output of the transistorized digital computers now in production will be stepped up, and new digital models capable of 500,000 ops probably will be developed within five years. With Free World technology and prototypes to assist them, the Chinese by 1975 should be able to reproduce -- but not mass produce -- advanced digital computers such as the French Iris 50. Output of analog computers may also be raised, and the transition from vacuum tube to solid-state design should be completed in all analog production models.

27. To upgrade their inferior peripheral equipment the Chinese almost surely will re-model their input/output equipment, using proven Western designs

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as prototypes. Production of a magnetic disc memory unit probably will be initiated, with correspondingly less effort devoted to producing magnetic drum memories.

28. Despite their experience with imported software, the Chinese will encounter difficulties in developing and making extensive use of high-level computer languages as they move into more advanced stages of the computer revolution. To judge from the difficulties experienced by the USSR, the Chinese will not be able to develop and master advanced software for their newer models at a rate comparable to hardware development. They almost certainly will emphasize scientifically oriented languages such as FORTRAN or ALGOL.

29. Despite the expected advances, Chinese production of computers during the next few years will not match, either quantitatively or qualitatively, the domestic requirements for these machines. Moreover, in view of the fast tempo of computer developments in the Free World, China's technological lag in computers may increase even further. Therefore, the Chinese almost certainly will continue to import advanced computers from Japan and Western Europe for operational purposes and for use as prototypes.

Conclusions

30. Communist China has been mass producing electronic computers for about a decade. Current production consists of digital, analog, and special-purpose models. Production of general-purpose digital computers is believed to be limited presently to three or four models, all of which are completely transistorized. The number of general-purpose analog models in current production is not known. At least one analog model is completely transistorized but vacuum tube models may still be produced. Special-purpose computers for process control, language translation, and control of machine tools also have been developed and some of these types probably are currently produced.

31. The initial development of computer manufacturing in China was facilitated by substantial assistance from the USSR. Early Chinese production models were

copies of Soviet computers. Since about 1965, however, the Chinese have had access to considerable Free World computer technology. Advanced computers, wiring diagrams, and technical guidance obtained from manufacturers in Japan and Western Europe have been instrumental in speeding the development and production of improved computers in China. Nevertheless, Chinese output of computers has failed to satisfy the rapidly growing demand, and technologically China remains far behind Japan, Western Europe, and the USSR.

32. During 1964-70, at least 72 computers, valued at about \$23.4 million, were imported from France, the United Kingdom, Japan, and West Germany. [REDACTED]

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33. The Chinese will respond to the increasing needs for electronic data processing by boosting domestic production and upgrading the capabilities of computers. With the assistance of Free World technology and prototypes, they should be able before long to develop new digital models with much higher speeds and to complete the transition to solid-state design in all analog production models. Input/output equipment probably will be remodeled, and production of a magnetic disc memory unit may be initiated. Software will be improved but not without difficulty. For the next few years, however, China will not be able to satisfy its computer requirements from domestic production, and almost certainly will continue to import computers, especially advanced types, from the Free World.

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